LIVERMORE LAB REPORT

A weekly review of scientific and technological achievements from Lawrence Livermore National Laboratory March 10-14, 2014.

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I SPY INSIDE A GIANT PLANET

Researchers are exploring the interiors of giant planets such as Saturn.

Using DESY's X-ray laser FLASH, Lawrence Livermore researchers and international colleagues took a sneak peek deep into the lower atmospheric layers of giant gas planets such as Jupiter or Saturn.

The observations reveal how liquid hydrogen becomes a plasma, and provide information on the material's thermal conductivity and its internal energy exchange, which are important ingredients for planetary models. The scientists present their experiments in today's (March 14) issue of the scientific journal *Physical Review Letters*.

The atmosphere of gas giants consists mainly of hydrogen, which is the most abundant chemical element in the universe. The researchers decided to use cold liquid hydrogen as a sample of the planetary atmosphere. Liquid hydrogen has a density that corresponds to that of the lower atmosphere of such giant gas planets. The scientists used DESY's X-ray laser FLASH to heat liquid hydrogen, almost instantaneously, from minus 253 to around 12,000 degrees Celsius and simultaneously observed the properties of the element during the heating process.

To read more, go to *Red Orbit*.

ScienceNews
MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC

CLOUDY WITH A CHANCE OF UNCERTAINTY

Clouds are one of the great mysteries when it comes to their effect on climate change.

Clouds are a mystery to climate scientists and are one of the biggest sources of climate uncertainty.

Clouds both trap and deflect planet-warming energy. Their molecules, like all water in the atmosphere, contribute to the greenhouse effect by lapping up infrared radiation emitted by Earth and redirecting some of that energy back toward the planet's surface. But clouds' white tops also reflect, collectively, almost a quarter of the solar radiation that reaches them, in effect shading the planet.

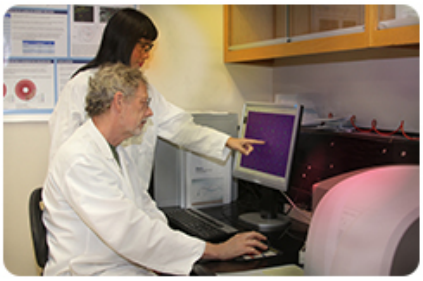
However, as the Earth warms, clouds will change, according to Lawrence Livermore researchers. Scientists expect these expanding cloud cells to push mid-latitude storm-tracks toward the poles, widening the low-latitude cloud-free belts where most planet-warming sunlight strikes. "Your cloud is essentially giving you less bang for your buck," explains Mark Zelinka, who studies cloud feedback at Lawrence Livermore.

A recent analysis of more than 30 years of weather data by Zelinka's colleagues Kate Marvel and Celine Bonfils provided evidence that storm tracks are moving poleward.

To read more, go to *Science News*.

SFGate

CLUES TO ANCIENT DEADLY DISEASES



LLNL biologist Crystal Jaing and computer scientist Kevin McLoughlin analyze an image from the Lawrence Livermore Microbial Detection Array (LLMDA). The LLMDA has been used for the first time to study pathogens from ancient human remains.

Lawrence Livermore scientists hailed as gene detectives have used a device developed at the Laboratory to detect the 14th century Black Death that plagued much of Europe, and cholera from a patient who died from the disease during the 1849 outbreak in Philadelphia.

Researchers at McMaster University and Lawrence Livermore tested the application of the Lawrence Livermore Microbial Detection Array (LLMDA) to identify human bacterial pathogens from archaeological remains. The team tested two samples that had been verified previously as containing pathogens through another technology.

LLNL biologist Crystal Jaing believes that the Lab's LLMDA technology will be tenfold faster and less expensive than current genomic sequencing as a means of studying pathogens in ancient DNA.

"Microarrays may be a potential alternative solution, as well as a complementary tool, to genomic sequencing for studying ancient DNA," she said. "It offers a faster and cheaper approach to studying complex samples."

To read more, go to the *San Francisco Chronicle*.

Bay Area Monitor DOWN THE DRAIN AND ONTO THE GRID

Researchers from Lawrence Livermore and Florida-based Chemergy Inc. plan to demonstrate an innovative bioenergy technology that converts wastewater treatment plant byproducts into hydrogen gas to produce electricity. The demonstration will be conducted at the Delta Diablo Sanitation District facility in Antioch, Calif.

Any time you wash your hands or run the garbage disposal, that daily waste ends up at a wastewater treatment facility, of which there are 40 in the San Francisco Bay Area.

The process that happens next -- the treatment of waste to remove chemicals and prepare it for reuse -- has been an energy-intensive one. However, researchers are making strides toward developing new systems aimed to reduce the amount of energy used for waste treatment -- and make the process energy-positive.

Lawrence Livermore has partnered with Florida-based Chemergy Inc. to work on a project that in one year will process one ton per day of wet biosolids from a treatment plant that will then be converted to hydrogen gas to produce up to 30 kilowatts of electricity. That electricity will be used to power select functions at the plant.

The project will demonstrate an integrated system on a limited industrial scale at the Delta Diablo Sanitation District (DDSD) facility in Antioch, Calif.

To read more, go to *Bay Area Monitor*.

The Christian Science Monitor **ENERGY SCAVENGER**

Researchers say that exhaust from home appliances could be harvested for future energy use.

In the energy-hungry world, there's nothing wrong with taking a little heat that is typically wasted and converting it into energy.

"Your computer, hot asphalt -- there's a million things that are fairly hot but not really viable for standard thermoelectrics," said Harry Radousky, a physicist at Lawrence Livermore and co-developer of a nanoscale harvester for low-temperature heat, such as exhaust from appliances. The small heat differences between low-temperature sources and their surroundings are much harder to convert into electricity than high-temperature waste-heat capture systems. But new low-temperature thermal-harvesting technology could turn these overlooked resources into working power.

For instance, Radousky said, "we park our cars in hot parking lots all over the U.S. in the summer, so in principle we could charge batteries in electronic devices, [and] run coolers to keep food cold" with heat from the pavement. Other prospects for reaping low-temperature thermal power include light bulbs, hot ovens and plastic seats inside cars baking in the sun. "My rule of thumb is that if it is too hot to touch, it's a candidate source," he said. "So we were looking for things that could harvest that low quality of heat ... where a small amount of energy can get you a long way."

To read more, go to *The Christian Science Monitor*.

LLNL applies and advances science and technology to help ensure national security and global stability. Through multi-disciplinary research and development, with particular expertise in high-energy-density physics, laser science, high-performance computing and science/engineering at the nanometer/subpicosecond scale, LLNL innovations improve security, meet energy and environmental needs and strengthen U.S. economic competitiveness. The Laboratory also partners with other research institutions, universities and industry to bring the

full weight of the nation's science and technology community to bear on solving problems of national importance. To send input to the *Livermore Lab Report*, send e-mail